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ABSTRACT

This is the first study in Taiwan to report the complex nature of the factors that influence exercise behavior among breast cancer survivors and to demonstrate cross-cultured applicability of the instruments. The natural progression of exercise participation over 6 months after completion of adjuvant treatment was observed to examine the relationship between those factors and exercise behavior among 196 women with stage 0-III breast cancer, mean age 47.63 ± 9.91 years.

Results indicated that women did increase their exercise participation over time and the overall amount and intensity of exercise participation were below recommended guidelines. At baseline, exercise frequency was significantly predicted by age, education, exercise history, social support for exercise, exercise self-efficacy, and two significant interactions. Surprisingly, exercise outcome expectancy did not predict exercise frequency. For change over time, the overall change of exercise self-efficacy was not significant, but exercise outcome expectancy and exercise frequency revealed significant changes over 6 months. Baseline age, mental health, exercise barriers, social support for exercise, exercise outcome expectancy made a significant contribution to explaining the variance in exercise frequency change over 6 months. The findings partially supported the study's model. The findings from this study would contribute significantly to the literature on psychosocial and exercise aspects of breast cancer survivors in Taiwan.

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INTRODUCTION

This annual report documents progress during the second year of this 2-year grant from Department of Defense Breast Cancer Research Program (BCRP) of the US Army. A total of seventy-five women completed questionnaires at one month after treatment completed (baseline-T1), one hundred twenty-four women at three months (T2), and one hundred sixty-two at six months (T3) between July, 2004 and March, 2005. Study participant numbers reflect only one year of DOD, not total sample size. The first purpose of this research was to examine the trends in exercise participation over 6 months after adjuvant treatment was completed. Results indicated that women did increase their exercise participation over time, however the overall amount and intensity of exercise participation were below the levels of exercise currently recommended by ACSM (American College of Sports Medicine, 2000).

This is the first study in Taiwan to report the complex nature of the factors that influence exercise behavior among breast cancer survivors and demonstrate cross-cultured applicability of the instruments. The PI endeavored to investigate efficacy patterns over three times periods, consequently allowing for an examination of the dynamic nature of exercise self-efficacy, exercise outcome expectancy and exercise behaviors. A model was proposed in the present study, and it provided the theoretical foundation. This report includes an examination of relationships among relevant factors including age, education, past exercise history, fatigue, physical health, mental health, social support for exercise, exercise barriers, exercise self-efficacy, exercise outcome expectancy and exercise behavior among Taiwanese breast cancer survivors based on the Social Cognitive Theory.

BODY

Data Report

A total of 196 women completed questionnaires at one month after treatment (baseline-T1), at three months (T2) the sample was 192, and at six months (T3) the sample was 191 for final data analysis. Descriptive statistics on demographics at baseline are presented in Table 1. Women ranged in age from 23 to 74 years with mean age 47.6 ± 9.9 years. Of the women, 39.3% were in age group 40-49, 74% were married, 37% were homemakers, 73% were originally from Fujian Province in Mainland China, 45.4% were Buddhist, 33.2% had completed university/college, and average individual monthly income was NT 20,000~NT 39,999 for 40.4% (1USD=32 NT). Medical profile of the subjects is presented in Table 2.

Details of the exercise behavior of subjects over time (T1, T2, and T3) are provided in Table 3. Of 196 subjects at T1, the average weight was 58.7 kg (SD: 8.72 kg; range: 38.8-88.0 kg), height was 157.4 cm (SD: 5.49cm; range: 142-172cm), and body mass index (BMI) was 23.7 % (SD: 3.53%; range 17.2-36.6%) which was within a recommended normal BMI (18.5-24.9). Most (67.9%, n=133) had a normal BMI and 28.6% (n=56) had a BMI of 25 or greater which is considered overweight (n=48) or obese (n=8). The average Karnofsky Score was 89.49. The majority (90.8%) of women felt good during exercise and 89.8% exercised for health reason. However, only 36.7% (n=72) had been exercising regularly, and 51.8% were interested in an exercise program provided by the hospital. The 121 exercisers' most commonly used activities at T1 were walking (n=61, 50%), hiking (n=24, 19.7%), calisthenics & folk dance (n=23, 18.9%), chi-gun & Tai-chi (n=18, 14.8%), fast

walking (n=11, 9.0%), and cycling (n=10, 8.2%). Only 16.3% (n=32) reported that they received exercise counseling through health professional or exercise experts. Those who were not interested in participating in an exercise program in hospital preferred to receive an exercise program at home, exercise on their own or receive exercise instruction from written materials, videotape, audiotape or internet.

None of demographic variables (except for age and education) and the medical variables assessed (types of breast cancer cells, stages, types of adjuvant treatment, types of surgery, and treatment days) were significantly related to exercise frequency. The correlation matrix (Table 4) revealed only small correlations between each of the predictor variables and exercise frequency (r= - .05~ .28), which supports the notion that these variables are independent factors.

Means and standard deviations for each instruments over time were calculated (Table 5). Internal consistency reliability was estimated with Cronbach alpha coefficients to demonstrate consistency for total scale scores. Overall, test-retest, and internal reliability were more than adequate. Face and content validity was determined by an 11-member panel of experts. The construct validity of the scales was established by the present study by factor analysis. An Principle Axis Factoring with varimax rotation was used to identify components. For main variables changed over time, the results showed that the scores of physical health, mental health, social support for exercise and exercise for outcome expectancy significantly increased, and overall fatigue scores revealed a significant decrease over time. The overall change in exercise barriers' and self-efficacy' scores were not significant over the 6-month period. Detail information regarding changes in each variable is showed in Table 6.

There were seven hypothesis proposed in this study: **I)** Each of the independent variables of age, education, exercise history, CRF, perceived health status, social support for exercise and exercise barriers will make a significant contribution to explaining the variance in exercise self-efficacy at baseline, **II)** Each of the independent variables of age, education, exercise history, CRF, perceived health status, social support for exercise, exercise barriers and exercise self-efficacy will make a significant contribution to explaining the variance in exercise outcome expectancy at baseline, **III)** Each of the independent variables of age, education, exercise history, CRF, perceived health status, social support for exercise, exercise barriers, exercise self-efficacy, and exercise outcome expectancy will make a significant contribution to explaining the variance in exercise behavior at baseline, **IV)** Exercise self-efficacy, exercise outcome expectancy, and exercise behavior will significantly increase from T1 to T2, T2 to T3, and T1 to T3, **V)** Each of the independent variables of age, education, exercise history, CRF, perceived health status, social support for exercise and exercise barriers at baseline will make a significant contribution to explaining the variance in exercise self-efficacy over time, **VI)** Each of the independent variables of age, education, exercise history, CRF, perceived health status, social support for exercise, exercise barriers and exercise self-efficacy at baseline will make a significant contribution to explaining the variance in exercise outcome expectancy over time, **VII)** Each of the independent variables of age, education, exercise history, CRF, perceived health status, social support for exercise, exercise barriers, exercise self-efficacy, and exercise outcome expectancy at baseline will make a significant contribution to explaining the variance exercise behavior over time.

The findings partially supported the research hypotheses. At baseline, the

overall model accounted for 29 % of the total variance in exercise frequency (hypothesis III). Exercise frequency was significantly predicted by age, education, exercise history, social support for exercise and exercise self-efficacy but not by CRF, perceived health status, exercise barriers or exercise outcome expectancy. Age, education, social support for exercise, and exercise barriers were significant predictors of exercise self-efficacy but CRF, exercise history, and perceived health status were not (hypothesis I). Age, education, physical health, social support for exercise, and exercise self-efficacy did have a significant direct effect on exercise outcome expectancy (hypothesis II). Detail information regarding relationships among each variable at baseline are showed in Figure 1.

For change over time, the overall change in exercise self-efficacy was not significant, but exercise outcome expectancy and exercise frequency revealed significant changes over 6 months (hypothesis IV, V). Baseline physical health, social support for exercise made a significant contribution to explaining the variance in exercise outcome expectancy change from Time 1 to Time 3(hypothesis VI). Baseline age, mental health, exercise barriers predicted the significant change in exercise frequency from Time 1 to Time 2 (hypothesis VII). Baseline age, social support for exercise, exercise outcome expectancy made a significant contribution to explaining the variance in exercise frequency change over 6 months (hypothesis VII). Detail information regarding determinants of the change in exercise outcome expectancy and exercise frequency are showed in Figure 2-4.

Discussion

Despite reports in the literature suggesting that regular exercise can have physical and psychosocial beneficial effects in improving quality of life for breast cancer survivors, only 39% of breast cancer survivors in this study indicated they engaged in moderate exercise at least three times per week for 20 to 30 min. However, this percentage is higher than breast cancer survivors (20%~ 32%) in the U.S. (Blanchard et al., 2003; Irwin et al., 2004; Pinto et al., 1998). The difference in the percentage of participation may be due to the participants' definition of "moderate" intensity having included light activities. The exercise diary revealed that those exercisers (T1: n=122; T2: n=147; T3: n=143) engaged in light to moderate intensity for approximately 15 minutes per day over six months [T1: duration-108 minutes (SD:89.05), frequency-7.52 (SD:4.86), intensity- 10.8 (SD:2.13) / per week; T2: duration- 110.81 minutes (SD:82.73), frequency-8.34 (6.50), intensity-11.37(SD:2.46) / per week; T3: duration-118.90 minutes (SD:82.58), frequency- 7.92(5.45), intensity-10.90 (SD:2.17) / per week]. The average time per session and intensity spent among this sample were actually below the recommended guidelines for exercise, although the women in this study exercised more frequently. There were significant increases in frequency, duration, and intensity of exercise from T1 to T2 ($p = .001$; $p = .010$; $p < .001$) and T1 to T3 ($p = .009$; $p = .004$; $p = .002$) among these 196 participants. These data showed that although this sample was not exercising at levels that can yield optimal health benefits, they expressed the intention to increase exercise levels. This finding suggests that women respond positively to being physically active as they recover from their cancer treatment.

General overall observations of the examination of baseline relationships includes: 1) of all the hierarchical multiple regressions conducted, no one large

significant predictor was observed, but 4-5 smaller significant predictors explained a modest to moderate percentage of the total variance in the three dependent variables; 2) age, education and social support for exercise were significant predictors for all three dependent variables; 3) exercise self-efficacy was a significant predictor for exercise outcome expectancy and exercise frequency; 4) cancer-related fatigue (CRF) and mental health were not a significant predictor for any dependent exercise variable; 5) other significant predictors were inconsistent.

General overall observations regarding changes over time includes: 1) modest amount of explained variance for change in exercise outcome expectancy and exercise behaviors, 2) baseline values of these dependent variables were significant predictors of T3 values, 3) age was a significant contribution and the interaction between age and social support for exercise was a significant contribution to exercise frequency change over time, and 4) CRF, only a minor role on its own, had a significant interaction with exercise history as a predictor of change in exercise frequency; 5) other significant predictors were inconsistent.

The appropriateness of some of the study's instruments needs to be re-evaluated. Fatigue is considered one of the most common and distressing symptoms of the cancer experience and can persist for months or even years after cancer treatment. However, the incidence of fatigue reported by women in the present study was inconsistent with these findings. It was surprising that only 84 (43%) at T1, 59 (31%) subjects at T2, and 40 (21%) subjects at T3 reported cancer-related fatigue (CRF) in this study which is a lower incidence than typically reported in the U.S. Although the revised Piper Fatigue Scale has its comprehensive measure of multidimensional fatigue from a subjective point of view and possessed good validity and reliability in this study, the questions are worded in such a way that this instrument apply only to those individuals currently experiencing fatigue. The true mean score of the Piper Fatigue score could not be used because you can not report having no fatigue and therefore an alternative ordinal fatigue score was created to represent levels of CRF which could include "no fatigue". Therefore, it might not be sensitive enough to measure CRF.

In addition, many participants had difficultly answering the Social Provisions Scale for Exercise Scale (SPSE) because of the wording of the questions. The SPSE assesses presence or absence of the provision of social support for exercise. The wording of the SPSE questions (the presence and the absence of the provision at the same time) really confused participants and resulted in difficulty answering, especially for Chinese population who are not used to questions stated negatively. Exercise self-efficacy scale provided good validity and reliability, however, it only assessed two resources of exercise self-efficacy (social persuasion, and physiological and affective states) but it was not designed to measure the other two important resources of exercise self-efficacy (enactive mastery experience and vicarious experience). Therefore, it might only partially measure the concept of exercise self-efficacy. A similar measurement issue may have occurred with the exercise outcome expectancy scale. Exercise outcome expectancy scale focuses on exercise benefits to general health but not specifically to breast cancer. Thus, the majority of women gave answers according to their knowledge and belief, and consequently reported a restricted range of scores (80%-95% answer fell into the range of "agree" and "strongly agree") on exercise outcome expectancy scale resulting in a "ceiling effect".

KEY RESEARCH ACCOMPLISHMENTS

Statement of Work

1. Task 1. Preparation for instruments in Chinese version, Months 1-3
   - Completed in the first year.
2. Task 2. Preparation for subject recruitment 3-4
   - Completed in the first year.
3. Task3. Subject Recruitment and Data Collection, Months 4-18
   - A total of 196 women completed questionnaires at one month after treatment (baseline-T1), at three months (T2) the sample was 192, and at six months (T3) the sample was 191 for final data analysis.
   - Completed clinic chart to gather information about treatments and routine laboratory tests of subjects.
   - Data management and data entry have been conducted.
4. Task 4. Data Analyses and Report Writing, Months 18-21:
   - Meetings for peer debriefing of interview data were scheduled periodically.
   - Meetings with Mentors and statisticians weekly for data analysis and writing report.
   - Final analyses of data were performed.
   - A dissertation and annual report were completed.
   - Two manuscripts are being written.

REPORTABLE OUTCOMES

1. One dissertation was completed- Determinants of Exercise for breast cancer survivors in Taiwan
2. A PhD degree was obtained.
3. Four poster presentations:
   a. Hsu, H. T., Dodd, M. J., Lee, K. A., Padilla, G. V., Facione, N. C., Hwang, S.L. (2005). Determinants of exercise for breast cancer survivors in Taiwan. The 8th National Conference on Cancer Nursing Research on February 3 - 5, 2005 in Ft. Lauderdale, Florida.
   b. Hsu, H.T., Huang, C.S., Padilla, G.V., Dodd, M. J., Lee, K. A., Hwang, S. L., Facione, N.C. Determinants of Self-Efficacy in Exercise among Breast Cancer Survivors(2005). The 30th Annual ONS Congress in Orlando, FL April 27-May 1, 2005.
   c. Hsu, H.T., Dodd, M. J., Huang, C.S., Liu, M.C., Hou, M.F., Hwang, S.L., (2005). Characteristics of Exercise Behavior among Breast Cancer Survivors: Application of Social Cognitive Theory to Predicting Stage of Change. The 23rd Quadrennial International Council of Nurses (ICN) Congress in Taipei, May 21-27, 2005.
   d. Hsu, H.T., Dodd, M. J., Paul, S.M., Lee, K. A., Padilla, G.V., Liu, M.C., Huang, C.S., (2005). Exercise in Taiwanese breast cancer survivors. U.S. Army Medical Research and Materiel Command's (USAMRMC's) Era of Hope 2005 Department of Defense (DOD) Breast Cancer Research Program Meeting in Philadelphia, Pennsylvania, June 8–11, 2005

CONCLUSIONS

We are currently on schedule with this study. With respect to the aims of the study, all data has been completely collected and analyses are proceedings along the timelines originally proposed. One dissertation and four poster presentations were accomplished. A PhD degree was obtained and two manuscripts are being written. Because participation in exercise behaviors is a complex phenomenon, a set of variables and their relationships has been proposed to explain participation in exercise behaviors more fully. Preliminary data from the present study indicates that there is abundant information related to exercise behavior among the breast cancer survivors in Taiwan. The findings from this study contribute to the literature on psychosocial and exercise aspects of breast cancer survivors, including understanding the trends of exercise behavior, which women are more likely to participate in exercise, what they see as major barriers for engaging in exercise, and demonstrating cross-cultured applicability of the instruments used in breast cancer survivors in Taiwan.

REFERENCES

Bandura, A. (1986). Social Foundation of Thought and Action: A social Cognitive Theory. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1997). Self-Efficacy: the Exercise of Control. New York, NY: W. H. Freeman and Company.

Breast Cancer Research and Treatment. (2000) Breast cancer in Taiwan [On-line]. Available: Specify path. http://www.witts.org/waroncancer/wista_woc_breast.htm

Frank-Stromborg, M., & Olsen, S. J. (1997). Instruments for clinical health-care research. Sudbury, MA: Jones and Bartlett Publishers.

Piper, B. F., Dibble, S. L., Dodd, M. J., Weiss, M. C., Slaughter, R. E., & Paul, S. M. (1998). The revised Piper Fatigue Scale: psychometric evaluation in women with breast cancer. Oncology Nursing Forum, 25(4), 677-684.

Resnick, B., Zimmerman, S. I., Orwig, D., Furstenberg, A. L., & Magaziner, J. (2000). Outcome expectations for exercise scale: utility and psychometrics. Journal of Gerontology, 55(6), S352-356.

Sechrist, K. R., Walker, S. N., & Pender, N. J. (1987). Development and psychometric evaluation of the exercise benefits/barriers scale. Research Nursing Health, 10(6), 357-365.

Sproule, M. B. (1999). Social support for exercise among women at four stages of change. U South Carolina, US.

Ware, J., Kosinkski, M., & & Keller, S. (1995). SF-12:How to score the SF-12, Physical and Mental Health Summary Scales (2nd Ed.). Boston: Health Institute, New England Medical Center.

APPENDICES

Table 1 Categories of Subjects' Characteristics at Baseline (T1)(n=196)

Categories	n	%
Age (years)		
20-29	8	4.08
30-39	30	15.30
40-49	77	39.29
50-59	58	29.59
60-69	20	10.20
70-79	3	1.53
Marital status		
Single	28	14.29
Married /Partnered	45	73.98
Separated	2	1.02
Divorced	13	6.63
Widowed	8	4.08
Employment		
Full Time	51	26.02
Part Time	12	6.12
Unemployed	1	0.51
Retired	18	9.18
Homemaker	73	37.24
Sick Leave due to Treatment	23	11.73
Laid Off due to Treatment	12	6.12
Other	6	3.06
Ethnicity		
Fukien	143	72.96
Mainland China	33	16.84
Ha-Ga	17	8.67
Aborigine	2	1.02
Religion		
No religion	51	26.02
Buddhist	89	45.41
Christian	24	12.24
Catholic	2	1.02
Taoist	29	14.80
Other	1	0.51
Education levels		
Illiterate	4	2.04
Grade1-6	35	17.86
Grade7-9	20	10.20
High school	60	30.61
University/college	65	33.16
Graduate school	12	6.12
Average individual monthly income (1NT=0.31USD)		
Less than 20,000	28	15.30
NT20,000~NT 39,999	74	40.43
NT40,000~NT 59,999	56	30.60
NT60,000~NT 79,999	13	7.10
NT80,000~NT 99,999	8	4.37
>NT 100,000	4	2.19

Table 2 Medical Characteristics of the Subjects at Baseline (T1)

Categories	n	%
Disease stages (n=193)		
In situ	8	4.15
I	51	26.42
II	101	52.33
III	33	17.10
Types of breast cancer cells (n= 195)		
Infiltrating ductal carcinoma	184	94.36
Ductal carcinoma in situ	6	3.08
Infiltrating lobular carcinoma	4	2.05
Adenoid cystic	1	0.51
Types of surgery (n=195)		
Lumpectomy	8	4.10
BCS/partial	52	26.67
MRM	133	68.21
Wide incision	2	1.03
Types of adjuvant therapy (n=196)		
None	8	4.08
Chemotherapy only	70	35.71
Radiotherapy only	10	5.10
Radio- and chemotherapy	108	55.10
Current Tamoxifen Use (n=196)		
NO	74	37.75
YES	122	62.25
Numbers of Chronic diseases (n=196)		
0	110	56.12
1	52	26.53
2	21	10.71
3	7	3.57
4	2	1.02
5	2	1.02
6~9	2	1.02
Categories	Mean(SD)	Range
Duration of adjuvant treatment in days	155.27(51.96)	41-344
Chemotherapy only (n= 69)	122.39(24.85)	56-182
Radiotherapy only (n= 10)	42.10(1.29)	41-45
Both radiotherapy and chemotherapy (n=108)	183.19(43.85)	71-344

Table 3 Clinical Data From Exercise Diary at T1, T2, T3

variables /stages	T1		T2		T3	
Categories	Mean(SD)	Range	Mean(SD)	Range	Mean(SD)	Range
Weight(kg)	58.67(8.72)	38.80-88.00	58.73(8.78)	40.00-87.80	58.64(8.84)	40.60-89.60
Height (cm)	157.35(5.49)	142.00-172.00	157.42(5.52)	142.00-172.00	157.39(5.53)	142.00-172.00
BMI (kg/m^2)	23.72(3.53)	17.18-36.60	23.74(3.58)	17.15-37.20	23.71(3.58)	16.92-36.44
BIA (n=150)	31.40(7.38)	18.00-56.00	30.58(6.55)	14.00-49.00	31.04(6.23)	17.00-49.00
n/ %	n	%	n	%	n	%
Karnofsky Score	89.49(7.00)		92.08(7.00)		93.14(7.00)	
100-Feel Normal	35	17.86	70	36.46	84	44.21
90-Minor signs or symptoms	122	62.24	93	48.44	82	43.16
80-Takes a bit of effort	35	17.86	28	14.58	23	12.11
70-Unable to carry on normal activity	2	1.02	1	.52	1	.53
60- Require Occasional Assistance	2	1.02	0	0	0	0
Exercise status :						
Never	8	4.10	8	4.17	5	2.63
Consider Exercise but no Action	60	30.77	27	14.06	22	11.58
Intend to Exercise but not Regular	51	26.15	48	25.00	38	20.00
Regular Exercise < 6 Months	54	27.69	72	37.50	53	27.89
Regular Exercise ≧ 6 Months	22	11.28	37	19.27	72	37.89

Categories/stages	T1		T2		T3	
	n	%	n	%	n	%
Does exercise make you feel good?						
NO	17	8.67	6	3.23	10	5.26
YES	178	90.82	180	96.77	180	94.74
N/A	1	0.50				
Exercise motivation:						
For health	176	89.80	165	85.94	164	86.32
For self	65	33.16	79	41.15	75	39.47
For meeting with partner	18	9.18	8	4.17	15	7.89
For meeting with friends	20	10.20	15	7.81	16	8.42
For walking dog	6	3.06	3	1.56	5	2.63
For other reason	11	5.61	11	5.73	9	4.74
For building muscle	6	3.06	5	2.6	7	3.68
Exercise counseling by a health care professional						
NO	163	83.16	146	76.44	148	77.89
YES	32	16.33	44	23.04	41	21.58
Missing	1	0.51	1	.52		
Pain Associated with Exercise						
NO	93	47.45	113	58.85	120	63.16
YES	30	15.31	34	17.77	23	12.11
N/A	73	37.24	45	23.44	46	24.21
Interested in exercise program						
NO	87	45.08	101	54.89	104	55.32
YES	100	51.81	80	43.48	84	44.68
Undecided	6	3.11	3	1.63		
Exercise history						
NO	124	63.26				
YES	72	36.74				

Table 4 Intercorrelation Matrix – the Relationships between Each of the Predictor Variables and Exercise Frequency

	1	2	3	4	5	6	7	8	9	10	11
1. age											
2. education	-.42**										
3. exercise history	.25**	- .12									
4. cancer-related fatigue	-.18*	.07	- .04								
5. physical health	-.01	.04	.01	-.44**							
6. mental health	.04	- .08	.08	-.34**	.19**						
7. social support	-.01	.07	.23**	- .10	.15*	.01					
8. barriers	-.04	.12	- .20**	.25**	- .27**	- .21**	- .33**				
9. self-efficacy	-.07	- .04	.20**	- .17*	.07	.15*	.39**	- .44**			
10. outcome expectancy	-.04	.05	.17*	- .12	.11	.08	.38**	- .37**	.38**		
11. exercise frequency	.13	- .06	.14	- .06	.13	-.05	.27**	- .19**	.28**	.08	

Table 5 Descriptive Statistics for Study Variables at T1 (baseline), T2, T3

Construct /stage (number of women)		T1(n=196)			T2(n=192)			T3(n=190)		
	# items	Score range (obtained)	Mean±SD	Cronbach α	Score range (obtained)	Mean±SD	Cronbach α	Score range (obtained)	Mean±SD	Cronbach α
Piper Fatigue Scale	22	0-9.95	4.88(2.14) (n=84)	0.97 (n=43)	0.27-9.14	4.97(1.87) (n=59)	0.96 (n=35)	0.68-9.05	4.84(1.97) (n=40)	0.98 (n=23)
Behavioral/Severity	6	0-9.8	4.92(2.44)	0.90(n=45)	1-10	4.92(2.42)	0.92(n=38)	1.67-10	4.82(2.20)	0.93(n=23)
Affective meaning	5	0-10	4.39(2.43)	0.93(n=80)	0-9.4	4.79(2.11)	0.89(n=55)	1.8-8.6	4.68(1.86)	0.93(n=39)
Sensory	5	0-10	5.33(2.32)	0.94(n=84)	0-10	5.40(2.03)	0.93(n=58)	0-10	5.08(2.25)	0.96(n=40)
Cognitive/mood	6	0-10	4.86(2.36)	0.93(n=84)	0-9.67	4.83(1.90)	0.89(n=59)	0-9.5	4.77(2.05)	0.95(n=40)
SF-12	12			0.85			0.87			0.85
PCS	12	24.41-60.77	42.73 (7.78)	0.72	29.97-64.21	47.26(7.72)	0.76	20.70-64.70	48.66(7.98)	0.76
MCS	12	18.09-64.64	46.23 (11.31)	0.85	9.6-65.75	48.44(10.78)	0.85	16.67-64.09	49.82(9.66)	0.79
Social Provisions Scale	24	27-92	60.81 (9.51)	0.87 (n=177)	36-92	61.91(8.64)	0.89 (n=172)	34-82	62.46(8.40)	0.89 (n=183)

PCS: Physical Component Summary; MCS: Mental Component Summary

Construct /stages (number of women)		T1(n=196)			T2(n=192)			T3(n=190)		
	# items	Score range (obtained)	Mean±SD	Cronbach α	Score range (obtained)	Mean±SD	Cronbach α	Score range (obtained)	Mean±SD	Cronbach α
Exercise Barriers Scale	22	1-3.09	2.06 (0.41)	0.91 (n=161)	1-3	2.00(0.38)	0.93 (n=166)	1-2.82	2.03(0.38)	0.92 (n=157)
Family,working, disease	8	1-3	1.90 (0.45)	0.85	1-3.30	1.87(0.43)	0.90 (n=168)	1-2.8	1.96(0.40)	0.82 (n=157)
Personality, emotion	8	1-3.5	2.16 (0.49)	0.83	1-4	2.08(0.42)	0.84	1-3.5	2.09(0.42)	0.86
Clothes, environment,time	6	1-4	2.01 (0.53)	0.80	1-3	1.95(0.49)	0.86	1-4	1.94(0.49)	0.88
Exercise Self-Efficacy Scale	19	0-10	4.46 (1.96)	0.93 (n=130)	0-10	4.69(2.15)	0.95 (n=131)	0-10	4.64(2.25)	0.96 (n=126)
Exercise outcome expectation	9	2-4	3.12 (0.42)	0.88	2-4	3.04(0.39)	0.89	1-4	3.03(0.47)	0.92
Exercise MET per day	1	2.57-214.38	41.15(39.33)	(n=122)	1.6-220.86	42.13(34.48)	(n=147)	3.75-162.26	41.44(33.12)	(n=143)
frequency per week)	1	1-28	7.52(4.86)	(n=122)	1-48	8.34(6.50)	(n=147)	1-37.00	7.92(5.45)	(n=143)
duration per week	1	10-570	108.49 (89.05)	(n=122)	8-490	110.81 (82.73)	(n=147)	15-435	118.90(82.58)	(n=143)
intensity per week	1	6-15	10.80(2.13)	(n=122)	6-20	11.37(2.46)	(n=147)	6-15.33	10.90(2.17)	(n=143)

Table 6 Predictor Variables Change Over Time (T1, T2, T3)(n=190)

	The ordinal version of Piper item 7		SF-12 PCS	SF-12 MCS	Social Support for Exercise Scale	Exercise Barriers Scale
	Mean Rank		M± SE	M± SE	M± SE	M± SE
T1	2.15	**T1**	42.73± .56	46.23± .81	60.82± .68	2.06± .03
T2	2.01	**T2**	47.29± .56	48.49± .77	61.93± .63	2.00± .03
T3	1.84	**T3**	48.67± .57	48.87± .70	62.50± .62	2.03± .03
		AIC	2885.29	4171.42	3955.14	
		Covariance Structure	CS	UN	UN	
df, Chi-Square	2, 23.68	**df, F**	2, 61.43	2, 11.81	2, 3.67	2, 1.822
P	< .000*	**P**	< .000*	< .000*	.039*	.170
Wilcoxon test significant	T1vs.T3, p< .000* T2vs.T3, p=.011*	**Pairwise significant**	T1vs.T2, p< .000* T1vs.T3, p< .000* T2vs.T3, p=.014*;	T1vs.T2, p=.002* T1vs.T3, p< .000*	T1vs.T3, p=.009*	None

Information criteria: AIC- Akaike's Information Criterion
UN: Unstructured
CS: Compound Symmetry

Figure 1. Determinants of exercise for breast cancer survivors at baseline.

Significant direct effects (a straight line→) and interactions (a dotted line---).

Pink lines: to predict dependent variable- exercise self-efficacy

Blue lines: to predict dependent variable- exercise outcome expectancy

Green lines: to predict dependent variable- exercise frequency

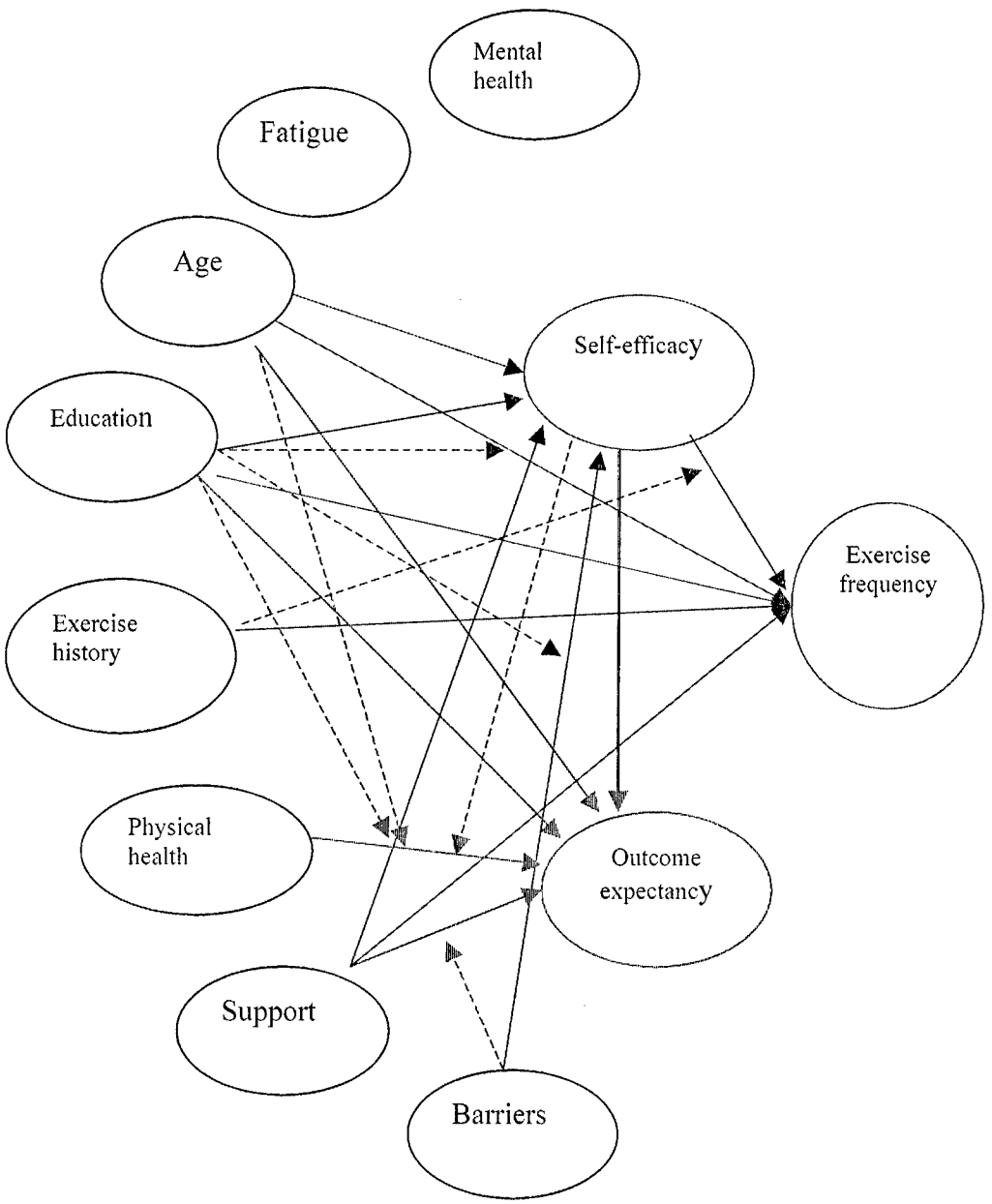

Figure 2. Change in exercise outcome expectancy predicted from T1 to T3. Significant direct effects (a straight line→) and interactions (a dotted line---).

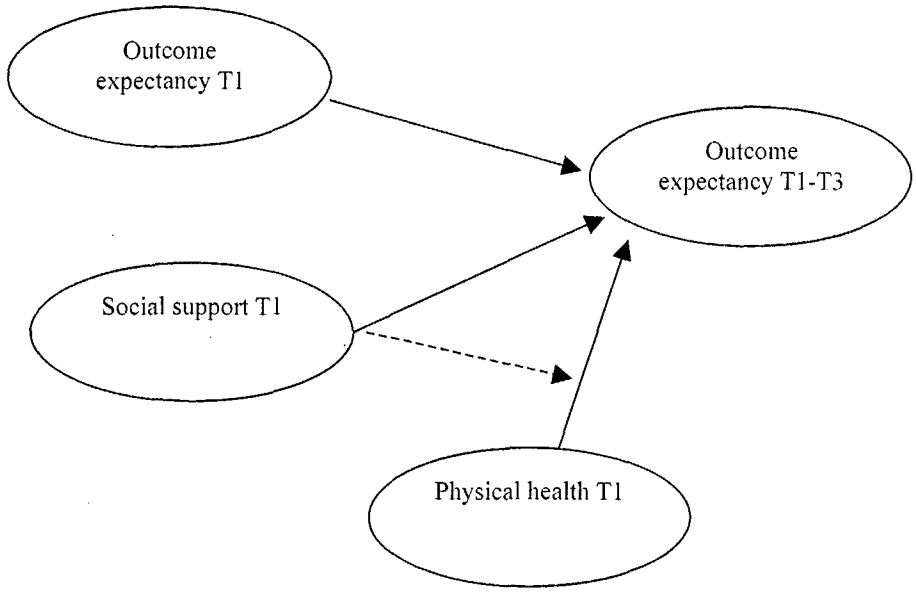

Figure 3. Change in exercise frequency predicted from T1 to T2. Significant direct effects (a straight line→) and interactions (a dotted line---).

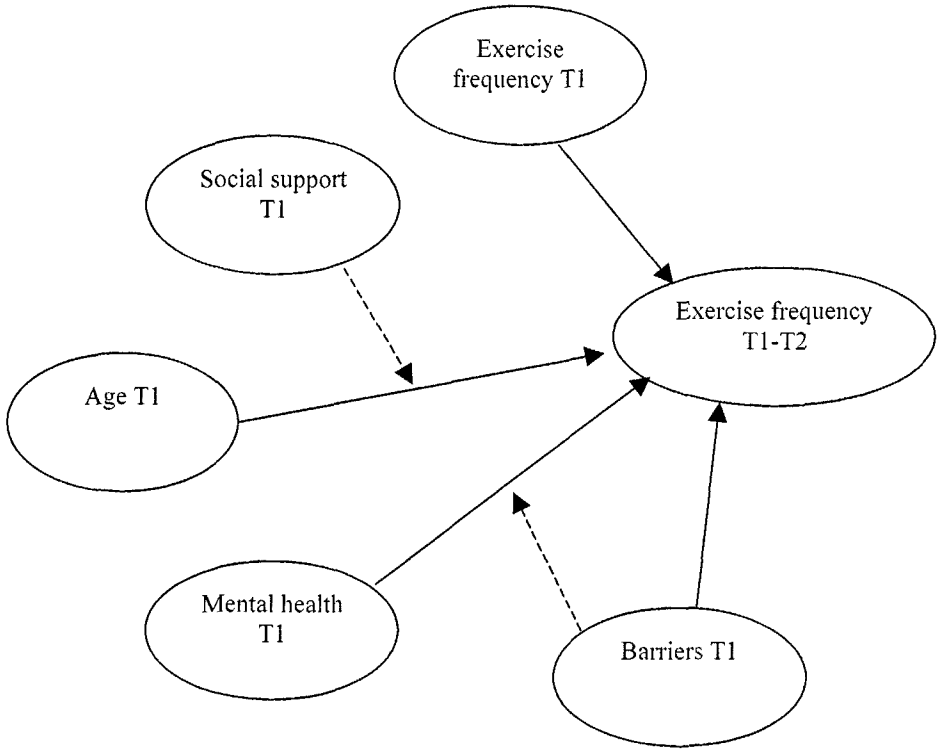

Figure 4. Change in exercise frequency predicted from T1 to T3
Significant direct effects (a straight line→) and interactions (a dotted line---).